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Thomas A. Enslow
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520 Capitol Mall, Suite 350
Sacramento, CA 95814

Re: Comments on California Building Standards Commission
Draft Environmental Impact Report
Adoption of Statewide Regulations Allowing the Use of PEX Tubing

Dear Mr. Enslow:

The California Building Standards Commission (BSC) proposes to adopt new state plumbing code regulations that would remove the prohibition against the use of cross-linked polyethylene (PEX) tubing for potable water uses from the California Plumbing Code.

Crosslinked Polyethylene (PEX) tubing use for potable water has been proposed for several years. During this time, I have written comment letters raising fundamental concerns over the public health, consumer protection and environmental effects of PEX. Comment letters of mine that have been submitted to the California Building Standards Commission (BSC) include:

July 23, 2001	Environmental effects of California adoption of PEX for potable water.
April 3, 2002	Information on environmental effects of PEX use for potable water.
January 13, 2003	Additional information substantiating the potentially significant public health, consumer protection, and environmental effects of adopting PEX pipe for potable water use.
September 9, 2003	Environmental effects of California adoption of PEX-AL-PEX for carrying potable water.
July 15, 2005	Comments on California Department of Housing and Community Development consideration of the use of PEX as potable water pipe
October 13, 2006	Comments on California Department of Housing and Community Development September 2006 PEX and PEX-AL-PEX Initial Study

Previous attempts at environmental review have been utterly lacking in objective, factual analysis. The 2008 DEIR is the first good-faith effort made to evaluate the potential impacts of PEX use in California. It is well written, far better researched, and avoids the advocacy for plastic pipe over copper that marred previous efforts. The DEIR addresses both the regulatory process and the technical substance of the expanded use of PEX. The

DEIR content reflects comments we made previously and attempts to address some of the technical issues we raised. There are several points in the analysis, however, where the presentation is overly verbal and short on quantitative fact and this leads to an underestimation of the potential impact.

The Project Description is incomplete.

The Project Description, Chapter 3, gives an overview of PEX without providing the detail needed to understand the significance of the extensive discussion of chemical leaching and mechanical failure presented later in the EIR. Chapter 3 describes the three PEX crosslinking methods, characterizing PEX-A, "peroxide is added to the base resin" without stating what peroxides are used. For PEX-B, "tubing is produced by blending this grafted compound with a catalyst." (p. 3-6) without identifying what catalyst may be involved.

The DEIR seems to place importance on the three different methods, but does not state whether the consumer has access to that information. Does the California Plumbing Code require PEX to be identified as to type by the mandatory pipe markings? Based on the analysis in the DEIR, would a consumer have a preference for one type over another to avoid chemical exposure or to ensure longer service?

Later the DEIR states, "The leaching of TBA and MTBE at levels that exceed the California notification level and primary and secondary MCLs for these chemicals is associated with PEX-A and certain PEX-B formulations that use t-butyl peroxide for cross-linking polyethylene piping, as discussed in Chapter 3, "Description of the Proposed Project." (p. 4.4-14) But Chapter 3 doesn't actually provide this information.

The only chemical discussion of additives in the DEIR Project Description is, "In addition to cross-linking the polyethylene, other chemicals are added to the resin to prevent oxidation and ultraviolet light from weakening the tubing, which could lead to tubing failures. Such additives include antioxidants, ultraviolet blockers, fillers, and pigments." (p 3-7) The DEIR doesn't actually list the commonly used compounds, e.g. the antioxidant Irganox 1010, so when it later concludes that the catastrophic polybutylene (PB) failure is really not relevant to PEX (4.2-12), it doesn't point out that they both use the same antioxidant system because of their chemical similarity and that the mode of failure is identical.

It is striking that the references listed for Chapter 3 include no industry or technical contact. (p. 9-1) Not even NSF International is listed as a source about the chemical characterization of the proposed project. This information is not impossible to find. BSC can ask NSF or the major PEX manufacturers. Industry suppliers publish information about their products. See for example Dow Corning's PEX-B masterbatch blend containing "vinyltrimethoxysilane, peroxide grafting catalyst and crosslinking catalyst" (Dow Corning News Aug 25 2006 on https://www.dowcorning.com/content /news /New_Silane_Blends.asp?). This begins to tell us about PEX-B.

The EIR needs to include a list of compounds used in the formulation of PEX tubing proposed for use in California. This information is available from manufacturers, from

patent literature, and from general trade knowledge. NSF International collects this information to guide pipe testing protocols, but the information supplied to NSF is subject to a confidentiality agreement. California BSC, however, can require disclosure as a condition of use in the state, subject to the limitation of California Public Records Act, Section 6254.7 of the Government Code, as prescribed by CEQA Guidelines 15120.(d). This defines a trade secret as "information which is not patented, which is known only to certain individuals within a commercial concern who are using it to fabricate, produce, or compound an article of trade or a service having commercial value and which gives its user an opportunity to obtain a business advantage over competitors who do not know or use it."

The basic formulation information cannot be protected as a trade secret. Arguably, information on precise amounts added, temperature and pressure cycles used in extrusion, or other aspects of the art may be "known only to certain individuals within a commercial concern", but that is not the kind of information required for the EIR.

A full disclosure of pipe manufacturing constituents would inform the EIR analysis of chemicals in potable water. It would list the compounds which are the origin of the methyl-tert-butyl-ether, tert-butyl alcohol, ethyl-tert-butyl-ether, carbon black, and others which the DEIR mentions, but does not trace to known pipe constituents, such as bisphenol A, benzo(a)pyrene, and benzene family aromatics.

The proposed PEX approval for California would continue long after the EIR is completed and new PEX formulations and new products will appear. The current DEIR analysis prompts mitigation measure 4.4-1: Noncompliance with Drinking Water Standards Resulting from Leaching. This measure refers to MTBE, TBA and "proposition 65 chemicals", but the enforcement of this measure requires some level of ongoing state oversight.

We recommend an additional mitigating measure for potential Public Health and Hazards impact: Any manufacturer of PEX pipe listed by NSF as suitable for use in California shall instruct NSF to disclose the formulation and manufacturing information provided to NSF which was used as a basis of NSF testing and certification.

The Environmentally Superior Alternative is rejected due to an unreasonably narrow Project Objective.

The DEIR does not adequately resolve the chemical leaching issue and it cannot reconcile the potential levels of chemical exposure from PEX pipe with current California standards. It is forced to conclude that "The No Project Alternative would be environmentally superior to the proposed project with respect to public health and hazards, leaching of chemical compounds into drinking water and indoor air quality." (p. 1-4) The DEIR rejects No Project as failing to "attain the project's objective of providing an alternative plastic hot and cold water plumbing material for use in California." (p. 1-4, 7-9)

The DEIR states, "BSC's objective in proposing these regulations is to provide an alternative plastic hot and cold water plumbing material for use in California." (p. 1-1) Unfortunately, the only alternative plumbing material under consideration in the DEIR is PEX. Actually, copper and CPVC are already available as alternate materials (to each other) and DEIR lists others when it cites UPC Table 6-4. The DEIR does not even speculate about alternate materials other than PEX, admitting that "there are no new plastic piping materials that the BSC is aware of that are not already approved for use in California …" (p. 7-3)

BSC's objective is approval of PEX and PEX alone. This narrow definition of project objective forces the identification of the environmentally superior alternative to be PEX approval.

The Mitigated Alternative relies on unproven and possibly infeasible regulatory mechanisms.

Despite the unresolved chemical exposure issue, the DEIR seems driven to find all effects as mitigated to insignificance. The DEIR identifies Alternative B: Mitigated Alternative. The Mitigated Alternative essentially proposes a new regulatory mechanism, relying on NSF International's testing program and the asserting that NSF will adapt its pipe approval process to produce what would amount to a special California listing. As described on DEIR p 1-4 and 7-9 this special California listing would require:

1. NSF certification that the pipe "meets California primary and secondary MCL, notification, Proposition 65 Safe Harbor, or other applicable Proposition 65 levels for drinking water". (based on Measure 4.4-1)
2. A warning notice that it cannot be installed under "slab unless a Phase 1 Environmental Site Assessment for the project is conducted following the ASTM E 1527-05 standard, which concludes that contamination of the soils or groundwater in the project area is unlikely, or unless the PEX is sleeved by a metal pipe or other proven impermeable barrier." (based on Measure 4.4-3)
3. Notice or code requirement that pipe used in "continuously recirculating hot water systems in jurisdictions where chlorination is used for disinfection of water, PEX tubing must be certified using the NSF P171-CL-R standard or a yet-to-be-adopted comparable standard." (based on Measure 4.2-3, numbered in DEIR as 4.2-1)

Although not mentioned in the definition of the Mitigated Alternative, Table 1-1 Summary of Project Impacts and Mitigation Measures lists several other measures which may be intended for application to the Mitigated Alternative:

4. Measure 4.4-2: Adverse Taste and Odor Impacts replicates the limitation of Measure 4.4-1 which is NSF certification that MTBE and TBA are below California levels.
5. Measure 5-1: Cumulative Noncompliance with Drinking Water Standards Resulting from Leaching. Cumulative exposure to MTBE and TBA requires PEX installed in "water service areas that have detectable levels of MTBE or TBA in drinking water or where there is known MTBE or TBA contamination of a source of drinking water" to be [NSF ?] certified not to leach detectable levels of MTBE or TBA.

It seems that the DEIR Measure 4.4-1 asks NSF International to certify some PEX as "California Clean" and Measure 5-1 asks for "California Super Clean". This special NSF California listing may not be feasible or practical, yet it is essential to the DEIR finding of no remaining significant impact. If comment by industry or by NSF itself demonstrate an unwillingness or inability to follow the DEIR proposal, then the EIR must find the health impacts of PEX use to be significant and unavoidable.

In a March 12, 2008 letter from Clifton McClellan, NSF International Director of Toxicology Services, to Valerie Nimba, Department of General Services, McClellan discusses the NSF test criteria for methyl-tert-butyl-ether (MTBE) and tert-butyl alcohol (TBA) and concludes that California has set too stringent a standard. California has often led the nation with more demanding standards and this is certainly appropriate in the case of PEX, but industry has usually resisted the imposition of California standards and it is not a foregone conclusion that the DEIR mitigation can be implemented. As vast as the California market may be, NSF may be loath to revise its certification process in a way that creates different classes of potential consumer exposure, creating the perception that NSF in effect selects better pipe for California and "dumps" lower quality pipe on the rest of the world.

DEIR Measure 5-1 requires no detectable levels of MTBE and TBA, but NSF methods have a detection limit which is above the relevant state criterion for TBA. Thus, even if NSF were willing to perform this "California Super Clean" certification, it would be meaningless, as NSF would pass pipe that could still leach TBA in quantities that would result in cumulative impact. Will NSF revise its testing method to lower the detection level to meet the intent of Measure 5-1?

Additional mitigation should be provided.

During review and approval of Chlorinated Polyvinyl Chloride (CPVC) pipe, the state addressed chemical leaching from solvent cement by requiring a pre-occupancy flushing protocol. A similar, or even more rigorous flushing protocol should be imposed on PEX.

There are two possible reasons to impose flushing. One would be as a substitute for the DEIR measures that would require pipe used in California to meet state criteria for MTBE and TBA when subjected to NSF/ANSI Standard 61. The available information in the DEIR, particularly the preliminary information in Appendix F NSF Over-Time Testing Reports, suggest that the initial burden of leachable chemicals may take several months to decline to acceptable values. Preoccupancy flushing to meet California criteria could take a long time, waste a lot of water, and be very hard to enforce.

A second reason to require flushing is so that DEIR measures requiring pipe to meet California criteria for MTBE and TBA under NSF/ANSI Standard 61 actually accomplish the intended objective, i.e. to prevent consumer exposure to high levels of this compounds. The data presented in Table 1 of Appendix F is most relevant. The first 16 days show extremely high and arguably unacceptable levels. The letter text of Appendix F states "when testing, the samples are conditioned for 16 days prior to the critical water collection on day 17." (p. 1). This refers to the test protocol for NSF/ANSI

Standard 61 which has the pipe test sample filled and emptied (flushed) for 16 days before the water is tested against the NSF criteria. If pipe installed in California is not flushed the same amount as the NSF protocol, then the consumer could be exposed to leachate concentrations well above the level that DEIR Measure 4.4-1 seeks to avoid even if the pipe passes Standard 61.

As noted above under Project Description, an additional measure is needed: Any manufacturer of PEX pipe listed by NSF as suitable for use in California shall instruct NSF to disclose the formulation and manufacturing information provided to NSF which was used as a basis of NSF testing and certification. This will ultimately be important in mitigation monitoring and enforcement and assure that changes in product formulation or new chemical exposure remains consistent with California criteria, particularly for proposition 65 chemicals.

The mitigation measures as described do not meet CEQA requirements for implementation.

CEQA Guidelines 15126.4 Consideration and Discussion of Mitigation Measures Proposed to Minimize Significant Effects. (a) (2) states that "Mitigation measures must be fully enforceable through permit conditions, agreements, or other legally-binding instruments." The majority of measures proposed by the DEIR fail this requirement since there is no practical way the state can impose and enforce the certification by a non-governmental, out-of-state entity. Section 15097. Mitigation Monitoring or Reporting. (a) states, "A public agency may delegate reporting or monitoring responsibilities to another public agency or to a private entity which accepts the delegation; however, until mitigation measures have been completed the lead agency remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with the program."

The EIR needs to show how all the recommended mitigation will be accomplished.

Public Health and Hazards from leachates and permeation are significant and not fully mitigated.

The public health effects of chemicals leaching from, or passing into plastic pipe has been a persistent concern. The DEIR relies on Appendix E, Water Quality Memorandum, by Ishrat S. Chaudhuri, Ph.D., ENSR, for an overview of potential leachates and a discussion of the various standards that may apply. The analysis in Appendix E is a welcome contribution to the subject.

Previous environmental documents relied blindly on the assurance that NSF testing and certification was sufficient to protect California consumers. Our objection to that was: 1) that NSF did not disclose the results of the testing so the state had no way of independently verifying results, and 2) that the NSF test criteria were not necessarily as protective as applicable California drinking water standards. The DEIR agrees.

The DEIR presents some NSF test data. The Water Quality Memorandum concludes that there are several potential chemical leachates for which California standards are

significantly more protective than NSF standards and that some of these chemicals are found consistently at levels that may pass NSF criteria, but which fail California criteria.

The DEIR reveals remarkably high levels of MTBE and TBA, explaining that these are likely the result of crosslinking agent reactions during extrusion.

The DEIR also lists ethyl-t-butyl ether (ETBE) as a contaminant. This is claimed to be from PEX-B (silane) and as a reaction product of a cross-linking initiator similar in structure to the di-tert-butyl peroxide which produces MTBE . As the DEIR points out, the chemical ETBE would be similar to MTBE; therefore the two should be considered together as a class of contaminant and effects considered cumulatively. The DEIR should have the California criterion for MTBE applied cumulatively to the class of alkyl-tert-butyl ethers. This will prevent a manufacturer using a mixture of peroxide crosslinking agents creating a significant cumulative exposure while MTBE itself is below the criterion.

The DEIR correctly finds that NSF will certify pipe under standard 61 that has leachate levels substantially above California criteria and that this is a significant impact. As stated above, the mitigation proposed for this impact may be infeasible and is insufficient without a companion measure requiring new pipe system flushing to at least the degree entailed in NSF/ANSI Standard 61.

The DEIR also correctly finds that PEX in contact with soil is subject to permeation by MTBE, benzene, or other relatively low molecular weight compounds that are often found in contaminated soil. The propose mitigation may be difficult to implement and will require every installation to undergo a level of toxic evaluation that may not normally be needed. The measure is also completely insufficient to protect against unknown, undiscovered, or future soil contamination. Although a great effort has been made to identify leaking underground tanks and to prevent further chemical contamination, it is ridiculous to claim that there will be no new contamination that can impact already installed, under-slab, permeable PEX.

The DEIR dismisses Bisphenol A without analysis.

DEIR Appendix E notes that bisphenol A is among the chemicals found by NSF to leach from system components, citing Tomboulian, P., L. Schweitzer, K. Mullin, J. Wilson and D. Khiari. 2004. Materials used in drinking water distribution systems: contribution to taste and odor. Water Science and Technology, 45(9): 219-226. The DEIR claims that "Many of these chemicals may not be found in PEX." (Footnote to Table 1, Appendix E). Indeed, a cursory consideration of PEX resin and pipe manufacturing does not show a reason to expect bisphenol A to be present in the pipe. If it is present, it may be a contaminant or an ingredient in some additive, or it may be a breakdown product of a constituent.

For example, Irganox 1010 is in essence four butylated hydroxytoluene (BHT) molecules joined as a tetra ester. As a result of free radical attack (its purpose in life), Irganox 1010 may break up or restructure; BHT subject to free radical attack is known to undergo condensation to form bisphenol derivatives (R.E. King, "Introduction to Polymer

Stabilization", American Chemical Society Meeting, San Diego CA 2001, p. 40) . Given the heavy dose of peroxide crosslinking agent in PEX-A and the inevitable premature degradation of the antioxidant, the detection of bisphenol A may be explained by this mechanism.

Bisphenol compounds may also be produced by the reaction of aromatic peroxide crosslinking agents such as dicumyl peroxide, which is in at least one formulation used in PEX-B.

The DEIR goes so far as to state, "PEX tubing, similar to other plastic products, has been found to leach various chemicals, including degradation products of antioxidants (which are added to the PEX during the manufacturing process to resist chlorine degradation). Drinking water standards have not been established for most of these antioxidant chemicals and many of them are unregulated; therefore, it would require speculation to reach a conclusion regarding the significance of any potential leaching of chemicals lacking drinking water standards into drinking water." (p. 4.4-14, emphasis added) Yet the DEIR doesn't attempt to identify these chemicals, so that they can be considered even in the absence of established standards. Perhaps bisphenol A is one of these "various chemicals".

The potential for bisphenol A in PEX illustrates the conflict between California's own emerging interest in regulating chemicals including bisphenol A and the reliance on the established NSF International listing program. NSF adheres to the position that relatively high levels of bisphenol A can be tolerated, based on toxicity and carcinogenicity tests. The recent controversy over bisphenol A revolves around its hormonal effects on child development, reproductive health, and promotion of certain tumors.

The NSF criterion for bisphenol A is 0.1 mg/L (100 ppb). The DEIR assumes that "since California does not have a drinking water criterion for this compound, it is assumed that the NSF criterion would also be considered protective in California." The current California approach to bisphenol A is through elimination of plastic products such as baby bottles and water bottles that are potentially significant sources of bisphenol A exposure.

Concern in California is over study findings that show estrogenic effects at very low doses (in the range of 0.025 ug/kg/day to 10 ug/kg/day) and there is definitely controversy over the process establishing the current EPA guideline of 50 ug/kg/day. The National Toxicology Program (NTP), U.S. Department of Health and Human Services, revisited the literature on low-dose exposure and concluded that "there is some concern for neural and behavioral effects in fetuses, infants, and children at current human exposures. (Draft NTP Brief on Bisphenol A, April 14, 2008, Peer Review Date: June 11, 2008, p. 37, emphasis original)

The Environment California Research and Policy Center white paper Toxic Baby Bottles, Scientific study finds leaching chemicals in clear plastic baby bottles, (Rachel L. Gibson, 2007) found levels of bisphenol A leaching from polycarbonate baby bottles in the 4 ppb to 10 ppb range – thus there is concern over levels that would easily pass the NSF criterion.

Tap water intake for infants depends on whether they are bottle fed from formula made up with tap water. The weight specific water intake for the 90th percentile of infants under 1 year of age is 103 mL/kg/day. For (weaned) children 1 to 3 years it is 51 mL/kg/day. (U.S. Environmental Protection Agency 2002, Child-specific exposure factors handbook. National Center for Environmental Assessment, Washington, DC; EPA/600/P-00/002B. Table 4-3. Estimate of direct and indirect community water ingestion by fine age category for U.S. children, Source: 1994–96 USDA Survey of Food Intakes by Individuals). At the NSF acceptable level of 0.1 mg/L, infants would be receive a dose of 10.3 ug/kg/day and young children would be receive a dose of 5.1 ug/kg/day. This would effectively double the exposure from existing sources estimated by the NTP (op. cit.)

Public concern over bisphenol A is real. The DEIR does not even attempt to determine whether or not the chemical is found in PEX and it dismisses consideration of it because there is no present California standard.

Mechanical Failure issue is linked to chemical leaching.

The concern over Mechanical Failure is still relevant and is being addressed by others. I will point out an aspect of mechanical failure that pertains to the consideration of chemical leaching into drinking water.

It is well established that PEX – as with all other polyolefins (PE, PP, PB) – is subject to oxidative attack which progressively breaks polymer chains and leads to catastrophic failure. The agents of attack: oxygen, chlorine, and ultraviolet light are unavoidable; PEX manufacturers add a substantial amount of antioxidant to forestall the inevitable demise of their product.

Technically, the antioxidant can be selected from a wide range of compounds, but most PEX has used sterically hindered phenolic compounds such as Irganox 1010 (Ciba Specialty Chemicals). Members of this class of antioxidants act as a terminating agent that suppresses the continuous autoxidation process of unsaturated polymer chains. The antioxidant stops this autocatalytic reaction by converting peroxy radicals to hydroperoxides and scavenging free radicals.

Due to concern over oxidation, manufacturers may be adding more antioxidants or trying different types of antioxidants to extend the life of PEX in oxidizing conditions (e.g. chlorinated water of low pH).

But, the crosslinking process that converts PE to PEX relies on free radical attack on the individual olefin chain to create new carbon-carbon bonds, or in the case of PEX-B, carbon-silicon-oxygen (silicone) bonds. The initiator of the crosslinking free radical is a peroxide, or in the case of PEX-C, an electron beam. In order to create the approximately 65% to 89% crosslinking needed for PEX to lose its thermoplastic susceptibility to high temperatures, a substantial free radical chain attack is needed.

Unfortunately, the antioxidant intended to increase PEX lifetime must be physically incorporated in the resin before the extrusion and crosslinking process is begun. The antioxidant will interfere with the action of the crosslinking agent with the result that some substantial loss of both antioxidant and crosslinking effect will occur during manufacture. Within limits, PEX manufactures can increase the starting amount of both antioxidant and crosslinking agent to counteract the effect. Resin reformulation may explain why the amount of chemical leachate crosslinking agent products such as MTBE, ETBE and TBA from PEX seem to have increased in recent years – there is more reactant chemical being added to the pipe mix.

Reformulation will continue as new issues such as oxidative exposure from chloramines appear or as new antioxidants such as sterically hindered amines are developed by industry to improve long term performance. The EIR should address the issue of the limitation of extending oxidation protection and increased crosslinking agent product left in the finished pipe.

* * *

In conclusion, we have been trying for years to get HCD and BSC to consider important information on public health and consumer protection. The current DEIR is a welcome beginning: it identifies several water quality and consumer protection issues which should be resolved before PEX is approved for use. The DEIR labels these potential impacts as significant, but mitigable. The mitigation measures in the DEIR, however, are inadequate as proposed, because they may be infeasible and because there is no mechanism for implementation and enforcement (monitoring) that is under the control of a California state agency.

Sincerely,

Thomas S. Reid